Communications Research Forum

Canberra, 2-3 October

Australia: Getting the Most from ICTs

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Abstract:

There have been calls for governments to foster the production of ICTs in Australia, in part to access productivity gains associated with ICTs. However, productivity gains can come through ICT *use*. Production is not necessary. Moreover, significant Australian production would face difficult market conditions. And there is the question of who would ultimately gain. Compared with other countries, Australia currently has one of the highest accumulated welfare gains from ICTs, because it imports most of its requirements.

This paper uses a growth accounting framework to compare the contribution of ICTs to productivity accelerations in Australia and the USA. Using the USA as a benchmark, it attributes up to 0.3 of a percentage point of Australia's 1 percentage point acceleration in labour productivity growth to ICTs. ICTs have had no net effect on capital deepening, as increased use of ICTs has substituted for other forms of capital. The contribution of ICTs is attributed to gains from business restructuring and innovations in product and process that they enable. The gains to date have been concentrated in distribution (especially wholesaling) and financial services. The evidence of spillovers and network economies is not (yet) strong or widespread.

The Australian experience suggests that the central tenets of policy reform — competition, openness and flexibility — have been important in driving the uptake of ICTs and assisting firms to use them in productivity-enhancing ways. This approach — focusing on the conditions in which business operates — has taken Australia toward the international forefront of ICT-related productivity gains and well on the way to getting the most welfare gains it can from ICTs.

Acknowledgements and disclaimer:

This paper draws on a paper delivered to a Conference on The New Economy convened by the International Association of Official Statisticians in London in August 2002. That paper in turn updated a paper written with colleagues, Paul Roberts and Haishun Sun (Parham, Roberts and Sun 2001). The views expressed in this paper are those of the author and do not necessarily represent the views of the Productivity Commission.

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1. Introduction

The conjunction of an ICT boom and an acceleration in productivity growth in the USA in the second half of the 1990s excited talk of a 'new economy'. A lot of the enthusiasm for the concept has subsided in the wake of the 'tech wreck'. But a more sober 'new economy' discussion continues.

The focus is on the links between ICTs and their effect on productivity growth. A central contributor has been the rapid technological advances in ICT production that have generated very strong productivity gains. In the USA, these production gains have been on such a scale as to show up in increases in aggregate productivity growth. The productivity gains have also led to rapidly declining ICT prices, which has stimulated increased investment in them.

Australia's productivity growth also surged in the 1990s (and more strongly than in the USA). However, Australia's takeoff pre-dated that of the USA and the magnitude of Australia's acceleration has been greater than that of the USA — suggesting that some different factors are at work in the two countries. Microeconomic policy reforms are widely considered to have played the major role in raising Australia's productivity performance (see, for example, PC 1999, Bean 2000, Dowrick 2000, Forsyth 2000, OECD 2001a). Some credit should be given to deft macroeconomic policy settings, especially in the face of the Asian financial crisis. Education levels in the workforce have also risen markedly over the past two decades and are likely to have played some role (Dowrick 2002, Barnes and Kennard 2002).

The tendency to link Australia's 1990s productivity surge primarily to policy reforms and not to an ICT boom has reinforced a view in some quarters that Australia has not accessed 'new economy' gains. Furthermore, the US evidence has been read to suggest that ICT *production* is needed to tap 'new economy' productivity gains. According to this view, the lack of a sizeable ICT production industry in Australia has been seen as a preventive barrier to ongoing higher productivity growth (see, for example, AiG 2000).

Some have advocated that governments encourage and develop Australia's ability to produce ICTs, in order to take Australia into the 'new economy' era (irrespective of the tech stock boom and bust). A central point of this paper is that this strategy does not make a lot of sense, given the realities of the market place. Australia has moved toward the international forefront in *use* of ICTs. 'Smart' ICT use can enable productivity gains through business restructuring and by providing a platform for further product and process innovations. As a user, Australia has benefited from the rapidly declining prices of ICTs and has generated productivity gains from the 'smart' use of ICTs.

2. The role of ICTs in Australia's productivity surge

This section reports on a conventional productivity growth accounting exercise, updated from Parham, Roberts and Sun (2001), which investigates the importance of ICTs in Australia's productivity surge.

2.1 The nature of the links between ICTs and productivity gains

Computers, telecommunication systems and the Internet have brought revolutionary changes to businesses, consumers, education, health, entertainment and many other aspects of life. A defining characteristic is that the costs of storing, accessing and exchanging information have been greatly reduced. In so doing, ICTs have reduced the costs of coordination, communications and information processing. But, increasingly, they have also facilitated changes in what businesses do and how they do it.

A particular analytical interest has centred on the links between ICTs and productivity growth. Many studies of these links have employed a growth accounting framework, based on national accounts approaches to productivity estimation. In these studies, ICTs cover equipment (hardware and software), but exclude the delivery of ICT-related services, such as telephony. The framework provides three avenues for ICTs to influence labour productivity:

- *Increases in capital deepening.* Labour productivity can rise as a result of higher capital use per unit of labour. Stronger investment in ICTs can raise capital deepening. However, many analysts have noted that this mechanism accords ICTs with no 'new' or special production qualities. As they have become cheaper, firms have substituted ICTs for labour and other forms of capital — as could happen for many other inputs.
- *Productivity gains in ICT production.* Producers' ability to manufacture much more powerful ICT equipment, with little increase in inputs, generates substantial MFP gains. If the gains are of sufficient magnitude and production is on sufficient scale, they can show up as contributions to aggregate MFP growth.
- *Productivity gains in ICT-using industries.* This is the most controversial source of ICT-related productivity gains. It requires that use of ICTs generates MFP gains.

The 'new economy' concept has always been vague; and whilst assessments have come to focus on ICT-productivity links, the debate on the nature and extent of those links continues. On the one hand, 'new economy' enthusiasts believe there are MFP gains from such sources as increasing returns from ICT use and spillovers from network economies. On the other hand, sceptics (especially Robert Gordon 2000) have either denied or found little evidence to support the existence of MFP gains from use. Dale Jorgensen accepts that there is a new economy, but without MFP gains from use. He believes the new economy lies in the productivity gains in ICT production and associated ICT capital deepening as firms substitute cheaper ICTs for other inputs (Jorgenson 2001).

There is, perhaps, some middle ground on the possibility of MFP gains. For example, US Federal Reserve Board Chairman, Alan Greenspan, pointed to gains that he believes come from greater and cheaper access to information — greater certainty, through the availability of real-time information about customers' demands and the location of inventories and materials flowing through complex production systems, which leads to less wastage from extra production, inventories and staff; more efficient and compressed distribution processes; the development of financial instruments to manage risks; and lower search and transactions costs in business-to-business transactions (Greenspan 2000a,b).

As will become clear, I believe there is Australian evidence to support this 'middle-ground' view that ICTs can support MFP gains by enabling further business restructuring and further innovation.

2.2 Australia is an advanced ICT user, not producer

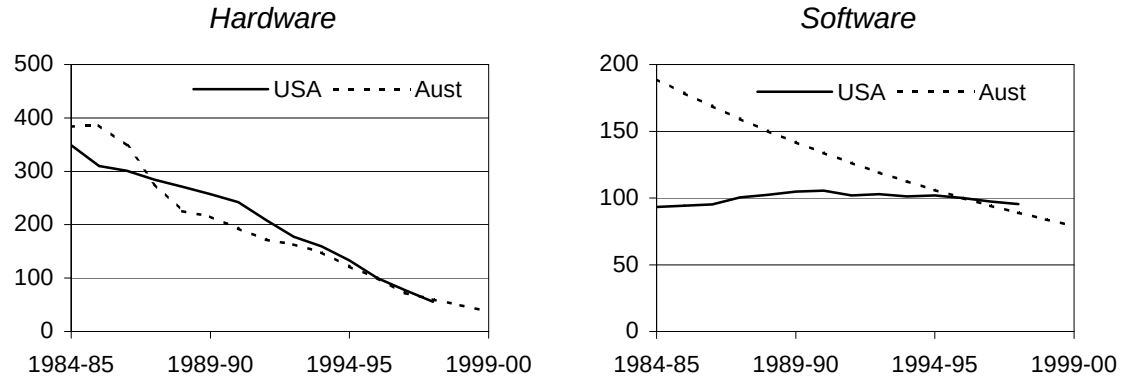
The measurement of ICTs has important bearing on the source and extent of estimated productivity gains associated with ICTs. The measurement of the volume of ICTs produced affects estimates of output and productivity growth in ICT production. The measurement of the volume of ICT investment affects estimates of growth in capital inputs and therefore the productivity residual in ICT-using industries.

In keeping with modern practice, the Australian Bureau of Statistics (ABS) uses hedonic (or constant-quality) price deflators to estimate real volumes of ICTs produced and purchased. Hedonic prices take into account changes in a number of characteristics of ICTs — processing speed, memory capacity and so on.

The quality-constant prices of ICT characteristics have declined markedly. This stems from the fact that, whilst there have been rapid technological advances (especially in the capacity of microprocessors), there has been relatively little movement in the nominal prices of equipment.

Hedonic prices have not been specifically generated for ICTs in Australia. The ABS uses the US price deflator for hardware, adjusted for exchange rate movements and a time lag, and an assumed 6 per cent a year reduction in prices of software. The US and Australian deflators are shown in figure 1.

Figure 1 **IT hardware and software price indexes, USA and Australia**
Index 1995-96 = 100



Source: Unpublished ABS data and BLS data.

Investment in ICTs became a sizeable proportion of total investment in Australia from the mid-1980s. Since then, the growth of investment has been very strong, especially in the 1990s, when investment in hardware grew by 35 per cent a year and software investment grew by 20 per cent a year in real terms.

Australia became a high user by international standards in the 1990s. It ranked 3 in 1999 among OECD countries in terms of proportion of business investment devoted to ICTs (OECD 2001b).

Australia imports most of its ICT equipment requirements. Australia ranks at the very low end of OECD countries in terms of size of its ICT equipment production industries.

2.3 ICT contributions to productivity growth — the USA and Australia compared

The contributions of ICTs to Australia's productivity growth are now assessed and compared with the US experience. With some assumptions, the US case provides a benchmark that indicates the extent to which Australia's productivity gains can be associated with ICTs.

There have been a number of US studies of ICT contributions to productivity growth (see Parham, Roberts and Sun 2001 for a partial review). For brevity, however, this paper focuses on comparisons with the USA, based on Bureau of Labor Statistics (BLS) data. Using BLS data brings two advantages:

- the ABS models its methods closely on BLS methods, and this enhances comparability[1]; and
- access to the BLS dataset assists flexibility in choosing periods for comparison.

A capital services measure of capital input is used and labour input is measured by hours worked. US studies also include a labour composition or 'quality' component, which captures changes in the hours worked by groups with different marginal products. A comparable component cannot be estimated for Australia.[2] Since allowance for compositional effects (as in the USA) effectively 'factors out' this component from MFP growth, this component is added back in to US MFP growth estimates, as presented below, to assist comparability with Australian estimates.[3]

Figure 2 shows that the year-to-year ICT capital deepening contribution to labour productivity growth has been quite similar in the USA and Australia from the mid-1980s. Both had a strong takeoff from 1995.

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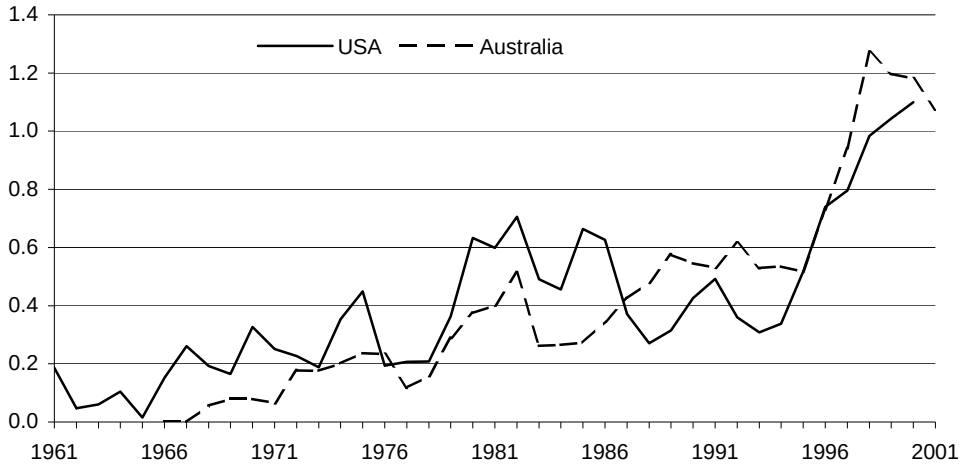
[1] Nevertheless, there are a few differences of note. Australian data cover IT, without communications equipment, whereas US data cover ICTs. The US estimates used here cover the private business sector, whereas Australian estimates cover the market sector. The main difference between the two is that the ABS-defined market sector excludes Property & business services.

[2] Barnes and Kennard (2002) use an experimental ABS labour services series to investigate the role of skill composition in productivity growth.

[3] This does, of course, assist comparability in a conceptually inferior way. It would be preferable to factor out labour composition in both cases. The practical significance of this issue rests on whether compositional effects would have been greatly different in the two countries. The work of Barnes and Kennard (2002) suggests that compositional effects in Australia would be broadly similar.

Figure 2 **Contributions of ICT capital deepening to labour productivity growth in the USA and Australia, 1961 to 2001**



Source: Productivity Commission estimates based on unpublished ABS data and BLS data.

With similar uptake of ICTs in the two countries, the USA can then be used as a benchmark to assess the extent to which Australia's productivity gains can be associated with ICTs. Furthermore, it seems reasonable to assume, consistent with the US leadership in productivity and ICTs, that US estimates establish the upper limit on productivity accelerations that can be associated specifically with ICT production and use.

First, however, there are some timing issues to sort out.

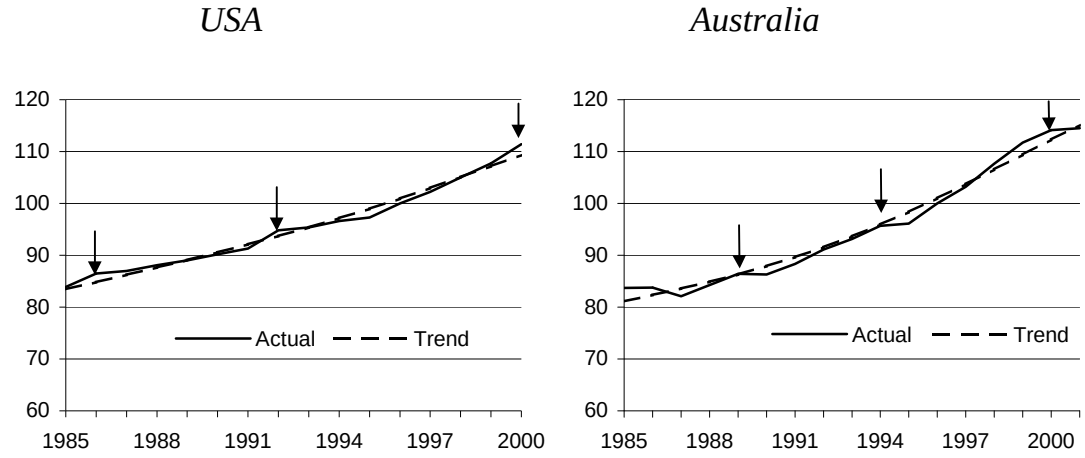
Most studies have used 1995 as the dividing year between periods of comparison of productivity growth and for assessing the ICT contributions to productivity acceleration — for example, accounting for productivity growth in the second half of the 1990s (1995-99) compared with the first half (1990-95).[4] The 1995 year corresponds to the take-off point in advances in ICT technology, declines in ICT prices, growth in investment in ICTs and, as just seen, growth in ICT capital deepening. The 1995 year also corresponds to the take-off in US labour productivity growth.

But 1995 was a trough year in US labour productivity, at a point below trend (figure 3).[5] Estimates from 1995 to the end of the 1990s are from a trough to a peak and therefore overstate the underlying rate of labour productivity growth.

4 Major examples of studies using pre- and post-1995 periods are Oliner and Sichel (2000), Gordon (2000), Jorgenson and Stiroh (2000) and CEA (2001).

5 A Hodrick-Prescott filter is used to form the trend series presented in figure 3. This does not clearly identify the Australian peaks as being above trend. However, the ABS uses an 11-period Henderson moving average to identify a trend series and (the same) productivity peaks in official productivity estimates.

Figure 3 **Identifying peaks in US and Australian productivity**
Index 1996=100



Source: Updated from Parham, Roberts and Sun (2001).

The use of 1995 as the boundary point between comparison periods tends to maximise the estimation of the ICT contribution; but tends to overstate the extent of the underlying labour productivity acceleration. Moreover, the size of the estimated labour productivity acceleration is quite sensitive to minor variations in period selection around 1995 (Parham, Roberts and Sun 2001).

Issues with the boundary point and sensitivity can be set aside by analysing contributions to trend rates of productivity growth. The ABS method of estimating productivity growth over productivity cycles — from productivity peak to productivity peak — is one way of measuring underlying rates of growth. Adopting this method puts the prime focus on accelerations in underlying rates of productivity growth, rather than on the ICT takeoff and its effects. The productivity-cycle method introduces a difference between countries in time periods compared, but it ensures that changes in *underlying* rates of productivity growth are compared.

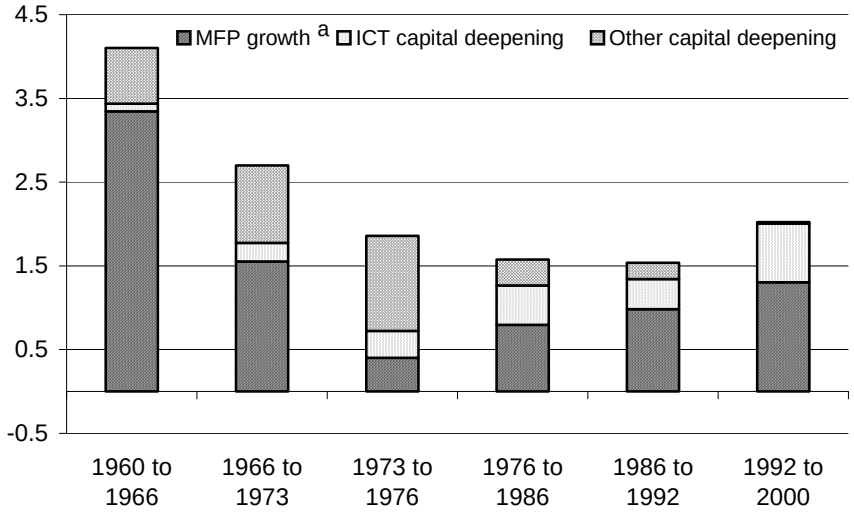
The contributions to labour productivity growth over productivity cycles are shown for the USA[6] in figure 4 and for Australia in figure 5. The 1990s cycle for the USA is from 1992 to 2000 and for Australia from 1993-94 to 1999-2000.

Contributions to the labour productivity *accelerations* in the 1990s cycle (compared with the previous cycle) in both countries are presented in table 1. The productivity accelerations from the first to the second half of the 1990s, and the contributions from capital deepening and MFP, are shown for purely comparative purpose in table 2.

6 The estimates in this paper do not reflect recent revisions to (quarterly) US labour productivity estimates over 2000 and 2001. At the time of writing, revisions to annual labour productivity and MFP growth estimates have not been released.

Figure 4 **Contributions to US labour productivity growth over productivity cycles, 1960 to 2000**

Per cent per year

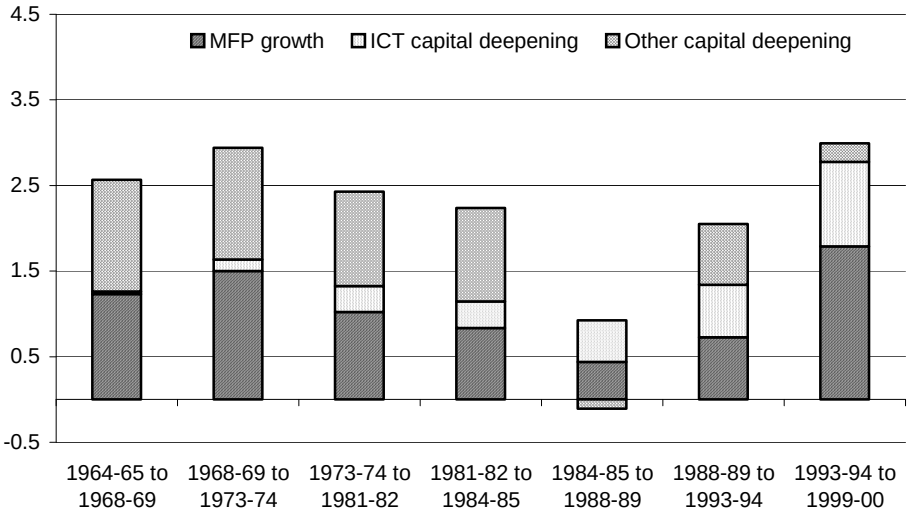


a Includes the labour composition (quality) contribution.

Source: Updated from Parham, Roberts and Sun (2001).

Figure 5 **Contributions to Australian labour productivity growth over productivity cycles, 1964-65 to 1999-00**

Per cent per year



Source: Updated from Parham, Roberts and Sun (2001).

Table 1 **Contributions to labour productivity accelerations in the 1990s cycle in the USA and Australia**

Per cent per year

	USA[a]	*Australia*[b]
Labour productivity growth	**0.5**	**1.0**
Capital deepening	**0.2**	**-0.1**
- ICT capital	0.3	0.4
* Hardware	0.3	0.4
* Software	0.1	0.0
* Other	0.0	
- Other capital	-0.2	-0.5
MFP contribution[c]	**0.3**	**1.1**

a Growth in 1992 to 2000 less growth in 1986 to 1992. **b** Growth in 1993-94 to 1999-00 less growth in 1988-89 to 1993-94. **c** MFP growth for the US includes the contribution to labour productivity growth from labour quality.

Source: Updated from Parham, Roberts and Sun (2001).

Table 2 **Contributions to productivity accelerations from 1990-95 to 1995-2000 in the USA and Australia**[a]

Percentage points

	USA	*Australia*
Labour productivity acceleration	**1.2**	**1.3**
Capital deepening contribution	**0.6**	**0.3**
• ICT capital	0.5	0.5
• Other capital	0.1	-0.1
MFP contribution	**0.6**	**1.0**

a For Australia, the periods refer to years ending 30 June.

Source: Updated from Parham, Roberts and Sun (2001).

There are several similarities in the US and Australian results:

- The estimated labour productivity acceleration is lower according to the productivity cycle method, compared with the pre- and post-1995 method. In particular, the US acceleration is a much less spectacular 0.5 of a percentage point (table 1), compared with 1.2 percentage points (table 2).
- ICTs have made strong capital deepening contributions. The ICT capital deepening contribution has increased steadily from the 1960s in both countries (figures 4 and 5). ICT capital deepening accounted for around a third of labour productivity growth in both countries in their respective 1990s cycles. ICT capital deepening made a contribution of a similar order of magnitude (around 0.3 to 0.4 of a percentage point) to the 1990s labour productivity *accelerations* in both countries (table 1).[7]

[7] The slightly lower contribution in the US was due to stronger labour input growth rather than weaker ICT capital growth.

- However, much or all of the increased use of ICTs in the 1990s has been offset by slower growth in the use of other forms of capital. There has been little or no increase in the overall rate of capital deepening in either country, especially in Australia (table 1). This contrasts with most other studies of the USA (exemplified by the results in table 2) which have found that ICTs have contributed to a marked increase in the rate of substitution of capital for labour.
- MFP growth accounted for over half of labour productivity growth in the 1990s cycle in both countries. Faster MFP growth accounts for most of the 1990s labour productivity *accelerations* in both countries, and entirely so in Australia.

The main difference between the US and Australian results lies in the strength of the productivity accelerations. The acceleration in underlying labour productivity growth in Australia, at 1 percentage point, is twice that in the USA (table 1). With similar capital deepening contributions, the chief explanation for the difference lies in the much stronger MFP acceleration in Australia (1.1 percentage point) than in the USA (0.3 of a percentage point).

It seems reasonable to assume, consistent with the US leadership in productivity and ICTs, that the US estimates establish the upper limit on productivity gains that can be associated specifically with ICT production and use.

Assuming that no other factor has generated a productivity *acceleration*, the US estimates set the upper limit on ICT-related gains. Some of the 0.3 of a percentage point MFP acceleration must be attributed to *production* of ICTs. Studies, such as Oliner and Sichel (2000), have attributed around 0.3 of a percentage point of aggregate MFP growth to ICT production, although the acceleration was calculated pre- and post-1995. The acceleration over productivity cycles would be less — perhaps half.

This leaves a contribution of perhaps 1 or 2 tenths of a percentage point from ICT use to the acceleration in underlying aggregate MFP growth in the USA.[8] Even if the more favourable pre-and post-1995 figures are used, the most that can be attributed to ICT use is 0.3 of a percentage point.[9]

Applying these US benchmarks to the Australian case (which requires the further assumption that any differences in industry mix in the two countries do not affect their aggregate productivity accelerations) suggests that the use of ICTs has contributed at most 0.3 of a percentage point and non-ICT factors have contributed the bulk (0.8 of a percentage

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[8] This does not necessarily mean that MFP gains associated with ICT use at the aggregate level will not grow in importance as product and process innovation continues. There was much stronger MFP growth in the USA in the second half of the 1990s and this may emerge as a consistent trend. The use of ICTs is also considered to have become sufficiently widespread only at the end of the 1990s for any large-scale and widespread gains from network economies to start to show up. A better indication of the effect of ICTs on underlying productivity growth, according to the method used here, will have to await the passage of another productivity cycle.

[9] The MFP acceleration in the USA was 0.6 of a percentage point (table 2). Taking Oliner and Sichel's estimates of 0.3 due to ICT production leaves, at most, 0.3 due to ICT use.

point or more) to the acceleration in Australia's productivity growth. The non-ICT part of the acceleration can be attributed largely to international catch-up and microeconomic policy reforms that have encouraged and enabled Australian business to move toward established best practice (Parham 2002).

3 An industry perspective

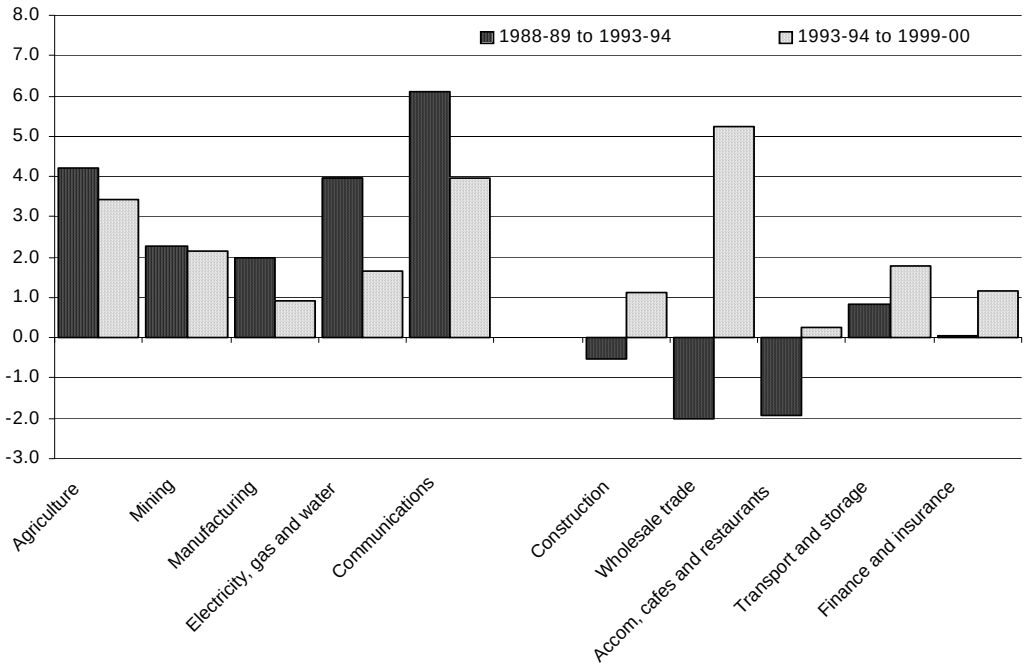
The above benchmark assessment does not in itself establish that ICTs have been at work in both countries. However, some supporting – though still circumstantial – evidence comes from an industry perspective, which shows an overlap in the USA and Australia in the industries that are both high ICT users and relatively strong productivity accelerators. Whilst the evidence suggests that the aggregate MFP gains to date from ICT use are significant, albeit not spectacular, there is evidence of strong links in certain industries.

Several studies of the USA have found evidence of productivity acceleration in the 1990s in Wholesale trade, Retail trade, Finance, insurance & real estate (especially in financial intermediation) and Business services. These industries have also been characterised as intensive users of ICTs (Stiroh 2001, Nordhaus 2001, CSLS 2000, CEA 2001, Pilat and Lee 2001).

A similar set of industries emerged in the 1990s as major contributors to Australia's productivity surge. Figure 6 presents MFP growth rates in industry sectors over the past two productivity cycles. In the first cycle (1988-89 to 1993-94), the relatively strong productivity growth in the 'traditional' contributors to aggregate productivity growth — Agriculture, Mining, and Manufacturing — is evident. These traditional sectors were joined in the 1980s and early 1990s by two other strong performers — Communication services and Electricity, gas & water.[10] Whilst productivity growth remained relatively strong in all these industry sectors in the 1990s cycle (except for Manufacturing), they all experienced a deceleration compared with the previous cycle. On these estimates, none made a contribution to the productivity surge from 1993-94. A new set of service industries made the positive contribution. The stand-out performer was Wholesale trade. Other service

[10] Their improved performance stemmed from the major reform-induced efficiencies achieved in government enterprises, which have dominated production in these areas, as well as technological advances in some activities.

Figure 6 **Industry annual average MFP growth over the last two productivity cycles in Australia, 1988-89 to 1993-94 and 1993-94 to 1999-2000**



Source: Productivity Commission estimates based on unpublished ABS data.

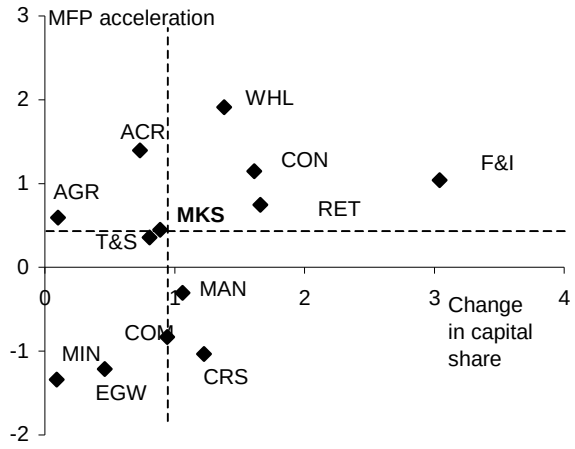
industries — for example, Construction and Finance & insurance — also increased their rate of productivity growth.

The pattern of increased ICT usage and MFP acceleration across industries is displayed in figure 7.

Whilst there is increased scope for measurement error at the industry level — of both ICT use and productivity growth — it appears that there is no strong, positive relationship between ICT use and MFP across all industries. There is a strong (above-average) positive relationship between increased ICT use and MFP acceleration in Finance & insurance and a weaker relationship in Wholesale trade.

The lack of systematic relationship undoubtedly reflects the fact that ICT use is not the only factor affecting industry MFP growth. It also signals that the productivity gains from ICT use appear — for the moment at least — concentrated in distribution and financial intermediation. (There may also be ICT-productivity links at the firm level in other industries that, because of inter-firm differences in these and other factors, do not translate as readily into industry or aggregate trends — see Brynjolfsson and Hitt 2000). The lack of a relationship across all industries also tends to support the view that the gains to date cannot be attributed to network economies, which could be expected to be more widespread.

Figure 7 **Change in industry ICT use and productivity growth in Australian industries over the 1990s[a]**



ACR	Accommodation, cafes & restaurants
AGR	Agriculture
COM	Communication services
CON	Construction
CRS	Cultural & recreational services
EGW	Electricity, gas & water
F&I	Finance & insurance
MAN	Manufacturing
MIN	Mining
MKS	Market sector
RET	Retail trade
T&S	Transport & storage
WHL	Wholesale trade

a The productivity acceleration is calculated as the change in *trend* MFP growth between financial years 1990-95 and 1995-2000.

Source: Parham, Roberts and Sun (2001)

The relationships between ICT use and productivity growth are complex. ICTs are often viewed as general-purpose technologies that require time to bring to their full potential and that provide a platform for other innovations in products and processes (see for example, Brynjolfsson and Hitt (2000) and Bresnahan, Brynjolfsson and Hitt (2002)).

The Australian evidence supports the view that it is the changes in products and processes that generate the productivity gains. The Finance & insurance industry has been restructured to operate much more through ICTs (for example, ATMs, Internet and phone banking) than through traditional face-to-face contacts. Many new products (for example, financial derivatives) are now on offer.

An earlier study by Productivity Commission staff (Johnston et al 2000) also found that ICTs played a part in the restructuring of wholesaling activities. Wholesalers were able to use bar-code and scanning technology and inventory management systems as part of the process of transforming wholesaling from a storage-based to a fast flow-through operation.

But, importantly, reforms were acting as the underlying drivers and facilitators of productivity gains and ICTs were just one component of change. It was not so much that wholesaling became much more ICT intensive or that new 'breakthrough' technologies became available. It was more that the competitive incentives to be productive became stronger and that new flexibilities became open to businesses to use ICTs as part of a more general process of restructuring and transformation.

For example, the motor vehicle industry was looking for efficiencies all along the 'value chain', including in distribution, to meet the increased competition from cheaper imports entering under lower trade barriers. Another contributor in some areas was the reform of industrial relations processes that allowed greater labour flexibility through the introduction of split shifts and reduced the rigidity of job demarcations.

At the general level, policy reforms have fostered productivity growth through three main avenues:

- sharpening incentives to be more productive, chiefly by strengthening competition;
- opening the economy to trade, investment and technologies developed overseas; and
- providing greater flexibility (for example, less regulatory restriction, more flexible labour markets) to adjust production processes and firm organisation to improve productivity.

These conditions have also provided the incentives for businesses to take up ICTs, as well as ready access to the latest ICTs developed overseas, and the flexibility to use ICTs to productive advantage.

4 Policy implications

A major implication of the evidence in this and other Productivity Commission papers is that, from a productivity and policy perspective, a prime focus on ICTs and the 'new economy' is somewhat misplaced. There are three potential pitfalls:

- too much attention on ICT production as a source of productivity growth;
- insufficient attention on the factors that drive ICT use;
- insufficient attention on other factors that are potentially the source of greater productivity gains.

On the first point, and in light of calls for policy action to foster the development of ICT production, the Australian (and the US) experience is now providing clearer evidence that there are also (MFP) productivity gains associated with ICT use. ICT production is not necessary to access productivity gains. The US estimates suggest that there have been roughly equal productivity gains at the aggregate level from ICT production and use in that country. However, if anything, the gains from use may well accelerate further in the future.[11]

But the scope for productivity gains in production in the USA does not translate as readily to other countries as does the scope for productivity gains from use. The US production gains come from a very large scale of operations and a degree of technological leadership that cannot be readily established in other countries. Aside from some niche areas (particularly in software), ICT production requires not only large scale operation but also sales in highly competitive international markets. This makes it tough going for a relatively small economy like Australia's.

Other advantages also come from focusing on use. By being open to imports of ICTs, Australia has been able to gain quickly from advances in ICT manufacture and has been able to capture a sizeable terms of trade gain from the rapidly declining international prices

[11] See footnote 8.

in ICTs.[12] Taking the benefits of productivity gains generated by foreign producers through lower prices is a real income gain to Australians.

An international comparison by Bayoumi and Haacker (2002) found that Australia is among the world's main beneficiaries from ICTs, even though it is not a significant producer. Welfare gains from lower ICT prices,[13] accumulated over 1985 to 2001, amounted to 5 per cent of GDP — not far short of the highest beneficiary, the USA, at 5.6 per cent of GDP. Australia benefits as a high-using importer with rapidly declining prices. But the estimated welfare gains in some major producer countries — Finland, Ireland, Japan, and Korea — have been lower than in Australia. And some major producers (such as Malaysia, Thailand and the Philippines) have not experienced major welfare gains.

The second point is that a direct focus on ICTs (and in particular on production) masks the importance of the pre-conditions required to drive the uptake and smart use of ICTs (where 'smart' implies business restructuring and complementary product and process innovations, based on ICT use). This paper has emphasised the importance of the incentives provided by competition. Sharper competitive incentives to be productive help to explain why Australia has moved from being a technology laggard in previous decades to being at the forefront of new technology uptake in the 1990s. Taking full advantage of declining prices and advances in technologies and not restricting them through trade or other barriers is also conducive to ICT uptake. And the development of skills in the workforce can also be important in identifying and developing applications for ICTs (Barnes and Kennard 2002).

Strong competition also affects the distribution of productivity gains. A competitive environment means that more of the gains are likely to be passed on in lower prices and thereby assist in dampening inflationary pressures.[14] ICT-related or other productivity gains do not in themselves dampen inflation, as some new economy advocates claim. Healthy competition is a necessary pre-condition.

Flexibility is also important in enabling the productivity-enhancing reorganisation of firms (outsourcing, better management of supplier and customer linkages) and work arrangements (team work, multiskilling, performance-based remuneration, shift arrangements) and so on.

The third and related point is that it is important not to lose sight of factors unrelated to ICTs that are the source of substantial productivity gains. The USA has enjoyed an MFP acceleration of around 0.3 of a percentage point associated with ICT production and use and

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[12] The Treasury (2002) stated that ICT prices have fallen in domestic currency terms by 9.5 per cent a year and raised the terms of trade by 0.3 per cent a year between 1985 and 2001. Since 1995, ICT prices have fallen by nearly 15 per cent a year and raised the terms of trade by 0.75 per cent a year.

[13] The concept of social saving is used. This is a generalised form of consumer surplus and covers the intermediate input usage by other producers, as well expenditure by consumers.

[14] Whilst the productivity gains appear to be concentrated in a few industries, competition means the benefits are enjoyed by a wider range of industries. Many services, including distribution and financial intermediation, are used extensively by manufacturing and other industries (Simon and Wardrop 2001). The productivity gains in Wholesaling, even though very large, were passed on, with profit margins declining in the 1990s (Parham, Barnes, Roberts and Kennett 2000).

perhaps other factors. Australia has enjoyed an MFP acceleration of around 1.1 percentage points associated primarily with non-ICT factors, but with some contribution from ICT use — not production. To state the obvious, it would be not make sense to focus on chasing a gain of (at most) 0.3 of a percentage point associated with ICTs — especially by concentrating on encouraging ICT production — if that came at the cost of realising a 1.1 percentage point gain from catch-up and 'smart use' of ICTs

But there is a big policy overlap between developing the conditions for catch-up productivity gains associated with restructuring and modernisation, on the one hand, and developing the conditions conducive to uptake and smart use of ICTs, on the other. Promoting effective competition, openness and flexibility is at the heart of both.

The Australian economy became more focused on productivity and more flexible at just the right time to take advantage of the advances in ICTs that came on stream in the second half of the 1990s. It was not so much that policymakers deliberately set out with an ICT strategy. Without many predicting or perhaps even realising it, Australia became 'ICT-ready' (and ready for any other technological development that could be usefully employed). Given a history of lagging in the uptake of technology and of relatively poor productivity performance, it is unlikely that Australia would have been as quick on the uptake of ICTs, or as able to use them in productivity-enhancing ways, had it not been for the sea-change that reforms brought.

Even though fostering the right business conditions should remain the policy priority, there are nevertheless ICT-specific policy issues to consider as well. These also cover the provision of ICT-related services and include:

- the optimal development of complementary innovations, based on ICTs;
- the optimal development of communications infrastructure;
- the implications of use of ICT networks for the strength of competition in markets;
- the development of appropriate ICT-related skills;
- adjustment issues concerning job flexibility for those with specific skills displaced by ICTs;
- appropriate protection of intellectual property rights in distribution via the Internet;
- access to networks, including the issue of the 'digital divide';
- regulation of network content; and
- security of tax bases through use of Internet and other networks.

5. Conclusions

Australia has entered the 'new economy' era in the sense that some of its productivity gains are associated with ICTs. Australia's link with the 'new economy' has come, firstly, from high investment in ICTs. However, the substitution of ICT growth for growth in other forms of capital has meant that there has been no overall capital deepening effect on underlying

labour productivity growth. Secondly, there is evidence that there have also been MFP gains associated with ICT use.

The production of ICTs is not necessary to access MFP gains. And so Australia's lack of significant manufacture of ICT equipment has not been a barrier to entry into the 'new economy'.

Australia experienced a strong productivity acceleration in the 1990s. Labour productivity accelerated by 1 percentage point and MFP by 1.1 percentage points.

Most of the MFP gains (0.8 of a percentage point or more) are attributable to international catch up. Microeconomic reforms have assisted this process by releasing the shackles on the economy that were holding back growth in productivity.

A relatively modest part of the MFP gains (up to 0.3 of a percentage point) can be more specifically attributed to ICT use. These gains have been focused in the distribution and financial services sectors of the economy. There is not strong evidence of widespread productivity gains from use of networks, such as the Internet (at least as yet).

Aside from the fact that production of ICTs is not necessary, government encouragement of local ICT production could be questioned on a number of grounds. Australia's cost structures, the competitiveness of the market and the need for large scale production and technological leadership would make it a tall task to establish significant and viable Australian production.

As an importer, Australia has also been benefiting from terms of trade gains from the declining prices of ICTs. Taking the benefits of productivity gains generated by foreigners through lower prices has been a source of real income gain to Australians. The welfare gains from ICTs have been greater to Australia than to most other countries, including many major ICT producing countries.

This also raises the question of where the welfare gains would go if Australia were to foster local production. If Australia became an exporter, at least some of the gains would go to foreigners. And it is by no means clear that Australian businesses would have the same access to the latest technological developments at the same declining price. This in turn could affect the rate of uptake of technologies and/or the rate of complementary investments in productivity-enhancing innovation.

The Australian experience suggests that the policy priority should be to enhance competition, openness and flexibility in the business environment, rather than focus too strongly or directly on ICTs and the 'new economy'. Policy reforms in Australia have provided competitive incentives for firms to take up ICTs, enabled ready access to the latest advances in ICTs and have ensured that firms have the flexibility to use ICTs in ways that help to transform their businesses and raise productivity. A focus on the right business conditions means that the 'smart' and productive use of ICTs — and substantial gains unrelated to ICTs — can then follow.

This approach — focusing on the conditions in which business operates — has taken Australia toward the international forefront of uptake and smart use of ICTs. It has generated large welfare gains by allowing maximum benefit from falling ICT prices and promoting associated productivity gains. There are always ways to improve further. But Australia has been on the right path to get the most welfare gains it can from ICTs.

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